DOCUMENT RESUME

ED 070 284 EM 010 558

AUTHOR	Towle, Nelson J.; Merrill, Paul F.
TITLE	Effects of Anxiety Type and Item Difficulty Sequencing on Mathematics Aptitude Test Performance. Tech Memo Number 46.
INSTITUTION	Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
SPONS AGENCY	Office of Naval Research, Washington, D.C. Personnel and Training Research Programs Office.
PUB DATE	20 Apr 72
NOTE	45p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Anxiety; Aptitude Tests; *Item Analysis; Mathematics Education; *Performance Factors; *Test Construction

ABSTRACT

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ED 070284

CAI CENTER

TECH MEMO

EFFECTS OF ANXIETY TYPE AND ITEM DIFFICULTY SEQUENCING ON MATHEMATICS APTITUDE TEST PERFORMANCE

Nelson J. Towle and Paul F. Merrill

Tech Memo No. 46
April 20, 1972
Tallahassee, Florida

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Project NR 154-280
Sponsored by
Personnel & Training Research Programs
Psychological Sciences Division
Office of Naval Research
Arlington, Virginia
Contract No. N00014-68-A-0494

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EM 010 558

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

Florida State University
Computer-Assisted Instruction
Tallahassee, Florida 32306

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE

Effects of Anxiety Type and Item Difficulty Sequencing on Mathematics Aptitude Test Performance

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Tech Memo No. 46, April 20, 1972

5. AUTHOR(S) (First name, middle initial, last name)

Nelson J. Towle and Paul F. Merrill

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
April 20, 1972	33	13

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
N00014-68-A-0494 b. PROJECT NO. NR 154-280 c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Personnel & Training Research Programs Office of Naval Research Arlington, Virginia

13. ABSTRACT

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DD FORM 1473 (PAGE 1)
1 NOV 65
S/N 0101-807-6811

Security Classification
A-31408

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

FORM 1473 (BACK)
DD 1 NOV 65
S/N 0101-807-6821

Security Classification
A-31409

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Tech Memo No. 46
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Project NR 154-280
Sponsored by
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Arlington, Virginia
Contract No. N00014-68-A-0494

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ABSTRACT

Effects of item difficulty sequencing on performance and on post-state anxiety were investigated using a timed mathematics aptitude test. The Ss were randomly assigned to a random, easy-to-hard, or hard-to-easy item difficulty sequence group. The hard-to-easy sequence group performance was significantly lower than either the random or easy-to-hard sequence groups. Though not statistically different, (1) the mathematics aptitude test scores of four achievement anxiety types grouped using the Achievement Anxiety Test, and (2) levels of state anxiety provcked by the three difficulty sequences were in the predicted direction.

EFFECTS OF ANXIETY TYPE AND ITEM DIFFICULTY SEQUENCING ON MATHEMATICS APTITUDE TEST PERFORMANCE

Nelson J. Towle and Paul F. Merrill

A continuing problem in the application of human learning research to educational procedures is that of adapting to individual differences among learners. While it is recognized in the field of educational training that individual differences in the learning process exist, little has been said about individual differences in the evaluation process. Few researchers have addressed their experimental efforts toward discovering and implementing methods of adapting to individual differences in the evaluation and testing procedures so necessary in our educational process. The purpose of this study was to investigate the presence of ATI type effects in a timed test situation such as is associated with standardized testing procedures.

When test results are used to categorize students academically for the purpose of grading or assigning to courses, and for assigning students to appropriate treatments discovered by investigators of aptitude treatment interactions, it is important that these test results be as accurate or valid as possible. These results should represent the level of attribute being measured rather than reflect the character of the testing situation.

One personality characteristic which is accepted by some educators as influencing test performace is test-taking anxiety. Alpert and Haber (1960), authors of the Achievement Anxiety Test (AAT) view test-taking

anxiety as being composed of two dimensions, facilitating anxiety and debilitating anxiety. This implies that for some persons an anxiety provoking situation, such as a testing session, facilitates their performance in responding correctly to test items, while for others, the same anxiety provoking situation debilitates test performance. Using students differing in levels of facilitating and debilitating anxiety, the present study sought to investigate the effect of test-item difficulty sequencing on Mathematics Aptitude Test performance scores.

Recent investigations of the practice in test construction of arranging test items in order of increasing difficulty have found no empirical evidence supporting such a procedure. Brenner (1964) administered tests composed of items for which the difficulty indices were determined by previous administrations of the test. Several different forms of the test were constructed with the same test items ordered in different experimental sequences. Brenner reports that no significant differences were discovered between experimental sequences on test difficulty or test reliability for the different sequences. He suggests, therefore, that there is no value for the average college instructor in spending the effort and time necessary to arrange the test items in a specific item difficulty sequence so as to obtain better test performance.

Berger, Munz, Smouse, and Angelino (1969) found no difference in the performance of high school students on three different item difficulty sequences of the Henman-Nelson tests of mental ability. Munz and Smouse (1968) found no statistical difference between item difficulty sequencing on the performance scores of a final examination in an introductory psychology course at the University of Oklahoma.

In another experiment, Smouse and Munz (1968) report no statistically significant differences between three item difficulty orders (easy-to-hard, hard-to-easy, and random) on a final examination in an introductory psychology course. Sweeney, Smouse, Rupiper, and Munz (1970) also reported no significant difference between easy-to-hard, hard-to-easy, or random item difficulty sequenced final examination performance for an introductory psychology course. Kestenbaum and Weiner (1970) using two forms of the Stanford Advanced Reading Achievement Test, report that the ascending versus random item difficulty orders have no differential effect on reading test performance.

Although the results of the studies cited above have produced no evidence to support the present convention in test construction of ordering items in an easy-to-hard sequence, several of the cited studies found interactions between item difficulty order and anxiety types. Munz and Smouse (1968) defined four anxiety types using the scores from the AAT. Facilitators were those students, making up about 25% of the total sample, whose facilitating anxiety scale scores were higher than the debilitating anxiety scale scores. Debilitators were defined as those students, about 25% of the sample, whose debilitating anxiety scores were considerably higher than their facilitating anxiety scores. For all remaining subjects the two scale scores were summed and ranked. The subjects scoring above the median of the summed scores were defined as high-affected and the subjects in the lower half of the distribution were defined as non-affecteds. Munz and Smouse (1968) discovered a significant anxiety type by item difficulty sequence interaction on the performance scores on a final exam in an introductory psychology course. On the random item difficulty sequenced form,

facilitators and high-affecteds scored significantly higher than the debilitators and non-affecteds. On the easy-to-hard form, facilitators scored significantly higher than the other three anxiety types. There were no significant differences among anxiety types on the hard-to-easy item difficulty sequenced final examination. Other attempts in searching for significant anxiety type by item difficulty sequencing interactions have not been productive. Berger (1969) using the same method of classifying anxiety types as described above, reported no significant interaction between anxiety types and item difficulty sequence in an experiment using the Henman-Nelson Test of Mental Ability with high school students.

If an instructional programmer is to intervene in a testing situation and attempt to match the characteristics of the learner so as to maximize test performance, he must know what characteristics of the testing situation he must manipulate. Munz and Smouse (1968) and Sweeney et al. (1970) have proposed the hypothesis that test performance is a curvilinear function (inverted U) of anxiety arousal as a plausible explanation for the interaction of anxiety types and item difficulty sequencing on performance scores. This explanation involves two assumptions. First, that item difficulty sequences are progressively more arousing or provoking in the order of random, easy-to-hard, hard-to-easy, and secondly, that under typical achievement testing conditions, the test anxiety reaction types have a characteristic position on the inverted U performance curve. To provide data for testing the first assumption, this study employs the use of the STAI (Spielberger, Gorsuch, & Luschene, 1969) to measure test-induced anxiety.

The STAI distinguishes between trait anxiety and state anxiety. State anxiety (A-State) refers to a transitory state or condition that is characterized by feelings of tension and apprehension and heightened autonomic nervous system activity. Trait anxiety (A-Trait) implies individual differences in anxiety proneness, i.e., the disposition to respond to elevations in A-State under conditions that are characterized by some threat to self-esteem. While measures of trait anxiety such as the AAT and STAI A-Trait scale should provide useful information regarding the probability that high levels of A-State will be aroused, the impact of any given situation on the intensity of A-State can only be ascertained by taking actual measurements of A-State in that situation.

The value of measuring state anxiety in a performance situation was demonstrated by a series of experiments conducted in the CAI Center at Florida State University (O'Neil, Spielberger, Hansen, 1969; O'Neil, Hansen, Spielberger, 1969). High A-State students made more errors on the difficult portion of a learning task than low A-State students, but they made fewer errors on the easier portion of the task. Level of A-Trait was not related to performance by either experiment.

Research experiments previously done in the area have generally used achievement tests as the experimental task. Achievement tests are important in that the results of achievement tests dictate to a large degree the progress of a student's career in school. Aptitude tests also wield enormous power in determining not only the educational future of students but also in determining and shaping self concepts.

Many educators depend heavily upon the results of standardized aptitude tests in decisions of academic placement of students. Though the uses of such standardized tests have recently come under fire from those concerned with "culture fair" tests, the "jangle fallacy" (Coleman and Cureton, 1966), and other factors, educators in our public schools continue to rely on these test scores for a measure of student's true ability or knowledge. In the light of the need for further examination of the results of aptitude testing, this study will use a typical, timed mathematics aptitude test as the basis of the experimental situation.

As the AAT has been used by researchers in several educational research efforts, the construct that is being measured by the AAT should be well defined for clear interpretation of the experimental results. A description of the construct is also essential for the results of this research to be applied in the classroom. An examination of several items contained in the AAT causes doubt that anxiety is the personological characteristic being measured. Several items on the AAT facilitating scale seem to relate to the attitude of the student toward taking tests rather than anxiety. To investigate this possibility a scale developed by one of the authors (Towle, 1972) was used to obtain a measure of attitude toward taking tests with which the AAT scores could be correlated. If the AAT facilitating and debilitating scales both measure test anxiety proneness (trait anxiety) then both scales should have a correspondingly high positive correlation with STAI A-State scale scores obtained immediately following a testing experience. However, since the results from previous studies have shown that the AAT scales correlate negatively with each other, it is doubtful that they will both correlate positively with the A-State scale.

Using as a basis the evidence provided in the aforementioned research, it is predicted that in the present study (1) item difficulty arrangement of test items will not significantly affect performance score, (2) students will report higher level of posttask state anxiety in the hard-to-easy sequence than in the other two item difficulty sequences, and (3) debilitators will obtain significantly lower performance scores than will the three other anxiety types. It is further hypothesized that (4) AAT debilitating scale will correlate positively with A-Trait and A-State and negatively with attitude toward test taking scale, (5) AAT facilitating scale will correlate negatively with A-Trait and A-State and positively with the attitude toward test taking scale.

Method

Subjects

The students used in this study were 82 volunteers recruited from mathematics classes at Tallahassee Community College, and from an educational psychology class at Florida State University. These students representing a wide range of backgrounds, included typical college-age students and mature adults with sophistication in mathematics ranging from basic arithmetic skills to facility with college geometry. All students were given credit by their instructors for participating in the experiment.

Materials

The instrument used as the basis for the testing situation in this study was composed of 48 items selected from the quantitative section of the aptitude test portion of the Florida Statewide Twelfth Grade Testing

Program. The results of the Florida Statewide Twelfth Grade Testing Program, and of similar tests, are employed in public schools and universities for academic counselling of students, evaluation of instruction, and other related purposes. The choice of the Florida Statewide Twelfth Grade Test as the source of test items for this study was made because of the broad usage of tests of this type in public schools and universities. Because of the origin of the test items, the resulting test was called the Mathematics Aptitude Test (MAT). Though the "jangle fallacy" proponents could criticize the name of the test, as the items could measure achievement as well as mathematics aptitude, for the purpose of this experiment, it is thought to be appropriate. Item difficulty indices supplied by the Board of University Examiners, administrators of the Florida Statewide Twelfth Grade testing program, were based on a random sample of 400 students from the entire statewide twelfth grade class membership for each of two years. Items were chosen to make up the Mathematics Aptitude Test on the basis of a wide range of difficulty indices. Each test item of the MAT consists of a stated problem to which there are given five possible multiple-choice responses. The three forms of the MAT were constructed by ordering the test items in easy-to-hard (EH), hard-to-easy (HE), and random (R) sequence and prepared in multilithed test booklets.

Other Measures

The A-State and A-Trait scales of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, and Lushene, 1970) were used to measure anxiety. The STAI A-State scale was employed prior to the administration of the task to obtain a base level measure of state anxiety. The

instructions of the pretask A-State scale asked the students to indicate how they feel "right now." The A-State scale was also given immediately upon completion of the task with the instructions requesting the student to indicate how he felt during the test he just completed. These latter instructions enable the student to give an indication of the level of anxiety that he experienced within the testing situation, and therefore, measured the degree to which the testing situation affected his level of anxiety. The Achievement Anxiety Test (Alpert & Haber, 1960) administered in this study was composed of the nine items of the facilitating scale (AAT+) and the ten items of the debilitating anxiety scale (AAT-) randomly interspersed as indicated by Alpert and Haber. The Attitude Toward Test-Taking (ATTT) Scale (Towle, 1972) was administered prior to the mathematics test to obtain an indication of the general attitude of the students toward taking any kind of a test. A second form of the ATTT with the items directed to the specific task situation was also used after the administration of the math test to obtain a measure of attitude toward the specific Mathematics Aptitude Test.

Procedure

The experiment was conducted in several sessions with 10 to 35 Ss in each session. On the basis of the order of their arrival for each experimental session, students were randomly assigned to one of three experimental conditions based on item difficulty sequencing of the MAT: random (R), easy-to-hard (EH), or hard-to-easy (HE). In each experimental session, approximately one-third of the students were assigned to each of the three conditions.

The experimental session consisted of three stages:

1. The pre-MAT stage. During this stage the students responded to the AAT, STAI A-State, STAI A-Trait, and ATTT self-report scales.
2. The mathematics testing stage. The MAT was administered as a typical timed standardized test. The student was allowed to write in the test booklet but indicated his choice of response by marking on a separate machine readable answer sheet. Instructions similar to those utilized in any standard testing session were given orally by the test administrator and further specific instructions were given in both written form and orally by the test administrator prior to the actual administration of the MAT.
3. The post-task stage. As the students may have completed the MAT prior to the end of the time limit (45 minutes), they were given instructions to respond to the post-task STAI A-State scale and the post-task ATTT scale immediately upon completion of the MAT or when time was called, whichever came first. The total testing session lasted for about one hour and 30 minutes.

Results

Personological Characteristic Measures

The descriptive statistics of the pre-task measures are given in Table 1, and the correlation matrix of all measures can be found in Table 2. The scores on the AAT- correlate positively with STAI A-Trait and A-State scores and negatively with both the AAT+ scores and the pre-task ATTT scores. As was expected, the AAT+ scores correlate

TABLE 1

Descriptive Statistics of Pre-task Measures

TEST	Number of Items	Means	S.D.	Alpha Reliability
STAI Trait	20	39.27	9.9	.90
STAI State	20	38.26	11.14	.91
ATTT	19	61.55	12.39	.92
Debilitating Scale of AAT	10	28.60	5.90	.80
Facilitating Scale of AAT	9	24.87	4.76	.63

n = 82

positively with pre-task ATTT and negatively with STAI A-Trait and A-State scores. Though no pre-task measure correlated significantly with MAT performance, the post-task A-State scores correlated negatively and the post-task ATTT scores correlated positively with MAT performance.

MAT Performance

To determine the effect of anxiety type on the MAT performance score the students were divided into facilitators, debilitators, high-affecteds, and non-affecteds by using the method described by Munz and Smouse (1968). This was accomplished by first subtracting the debilitating anxiety scale (AAT-) score from the facilitating anxiety scale (AAT+) score and ranking the differences. Those Ss with a positive difference were defined as facilitators (N=20, approximately 25% of the Ss), while 25% of the Ss with the largest negative difference were

TABLE 2

Correlation Matrix - All Subjects

	STAI A-State (pre-task)	ATTT (Trait)	AAT Debili-tating	AAT Facili-tating	MAT	STAI A-State (Post-task)	ATTT (Task Specific)
STAI A-Trait	.69*	-.36*	.59*	-.36*	-.12	.69*	-.38*
STAI A-State (Pre-task)		-.34*	.50*	-.32*	-.14	.73*	-.26*
ATTT (Trait)			-.35*	.52*	.06	-.33*	.60*
AAT Debilitating				-.50*	-.19	.52*	-.25*
AAT Facilitating					.10	-.30*	.30*
MAT						-.24*	.34*
STAI A-State (Post-task)							-.43*

* $p < .05$, $n = 82$

defined as debilitators (N=20). For the remaining subjects, the two scores, i.e., AAT+ and AAT-, were summed and ranked. Those scoring above the median in the resulting distribution were defined as high-affecteds (N=20), while those below the median were defined as non-affecteds (N=20).

The MAT score means and standard deviations of each of the anxiety type by sequence cells are shown in Table 3. These data were evaluated by a two-factor analysis of variance using the computer program AVAR23 (Veldman, 1967) with anxiety types as the first factor and item difficulty sequences as the second factor. This analysis revealed a significant sequence effect ($F = 4.15$, $df = 2/70$, $p < .05$). Multiple t tests showed that the MAT scores for the hard to easy sequence groups were significantly lower than corresponding scores from either the random ($t = 2.0$, $df = 70$, $p < .05$) or the easy to hard sequence groups ($t = 3.20$, $df = 70$, $p < .01$). This result is in direct contrast to the results of Munz and Smouse (1968), Brenner (1964), and others. Anxiety type ($F = 1.85$, $df = 3/70$, $p = .14$) and the anxiety type x sequence interaction ($F = .65$, $df = 6/70$, $p = .69$) were not significant. An examination of Table 3 shows the obvious differences in variances and cell sizes. These factors accompanied by low power may have produced the significant sequence effect while not producing a significant anxiety type effect. A subsequent study with increased sample size might produce a significant anxiety type effect.

A multiple linear regression analysis probing for ATI effects using the pre-task measures as predictors and the MAT as criterion produced no significant results.

TABLE 3

Mathematics Aptitude Test Cell Means and Standard Deviations

Test Item Sequence	Anxiety Type												TOTAL		
	Facilitators			Debilitators			High-Affecteds			Non-Affecteds					
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Random	27.0	6.66	6	24.75	11.65	8	26.55	9.06	9	25.8	9.44	5	26.0	9.0	28
Easy to Hard	33.0	6.72	6	22.75	5.5	4	29.14	10.06	7	28.6	7.11	10	28.85	7.9	27
Hard to Easy	21.0	6.68	8	16.38	4.98	8	21.00	12.78	4	27.14	11.84	7	21.22	9.[illegible]	27
TOTAL	26.4	8.13	20	21.0	8.91	20	26.35	10.06	20	27.5	8.94	22	Grand Mean =25.36		
													# Items = 48		

Effect of Item Difficulty Sequencing on Post-task State Anxiety

To provide a basis for subsequent analysis of A-State scores, a one factor repeated measures analysis of variance was computed with the two administrations of the A-State scale (Pre-task A-State mean = 38.3, post-task A-State mean = 41.9) as the repeated measures. The results indicate that the testing situation did significantly raise the level of A-State of the total sample of Ss ($F = 13.994$, $df = 1, 81$, $p < .001$).

Using the pre-task STAI A-State scores as a covariate on the post-task STAI A-State scores, the effect of the three difficulty sequencing orders was determined. The results of a one-factor analysis of covariance produced no significant sequence effect ($F = 1.28$, $df = 2/78$, $p < .20$). The adjusted means on the after task STAI A-State scales for the random, easy-to-hard, and hard-to-easy sequences were 41.58, 40.25, and 44.00, respectively.

Discussion

The previous findings that different item difficulty sequences of test items does not significantly affect performance scores was not supported in the present study. In this study, the hard-to-easy item difficulty sequence produced significantly lower performance on a mathematics aptitude test. In addition, the assumption by Sweeney, et al. (1970) that item difficulty sequencing differentially affects arousal was not statistically upheld in this study, though the direction of results was in the predicted order. The third hypothesis that the debilitators' performance would be significantly lower than the other three anxiety types, was not upheld in this study.

The differences between the results obtained in this study and those of previous research efforts may be partially explained by the structure of the testing situation employed. The previous studies employed achievement tests in which test scores are not usually dependent upon the time allowed for the test. Each student is generally allowed time to attempt each test item on achievement tests, while the limited time allowed in the aptitude testing situation used in this study obviously did not allow all students to spend time on each test item. An examination of item scores shows the mean of number of items attempted in the random, easy-to-hard, and hard-to-easy item difficulty sequences were 45.7, 42.6 and 38.2, respectively. In the hard-to-easy sequence, the average time per item could be inferred to be high on the beginning items and decreasing as the easier items were reached. Conversely, the average time per item in the easy-to-hard sequence would be low in

the beginning and increase as the test progressed. Therefore, it would be expected that the students in the hard-to-easy sequence attempt fewer items in the time allowed than would the students in either the easy-to-hard sequence, or the random sequence. Thus the lower score for the hard-to-easy item difficulty sequence group would be related to the fewer items attempted.

The lack of a positive correlation between the AAT Facilitating scale and the STAI A-State scale given after the test supports the assertion that the Facilitating scale does not, in fact, measure anxiety.

Conclusions and Implications

The finding that the HE sequence significantly reduces performance in the present study seems to indicate that the hard-to-easy item difficulty sequence in a timed aptitude test situation is not appropriate. The different time requirements of the test items of different difficulty indices cause fewer items to be attempted in the hard-to-easy sequence than in either of the other two sequencies.

The assumption that the anxiety arousing characteristics of the three item difficulty sequences are different was not upheld. The hypothesis of the inverted-U performance curve as proposed by Munz and Smouse (1968) needs to be reexamined in light of this finding.

The third hypothesis, that debilitators would score significantly lower than the three other anxiety types, was not upheld. The lack of positive correlation between the AAT+ and post-task STAI A-State scores introduces doubt as to the value of the anxiety measuring characteristic

of the AAT+. Though the usefulness of the AAT presently is in determining the testing situation in which a student would be most productive, there may be a future application for the AAT in fine grained adaptive instruction evaluation. Figure 1 gives an indication of the most appropriate item difficulty sequence assignment of students differing in AAT scores. It would seem, based on these data, that the EH sequence would be appropriate for each of the anxiety types except the debilitators, who should receive the random sequence.

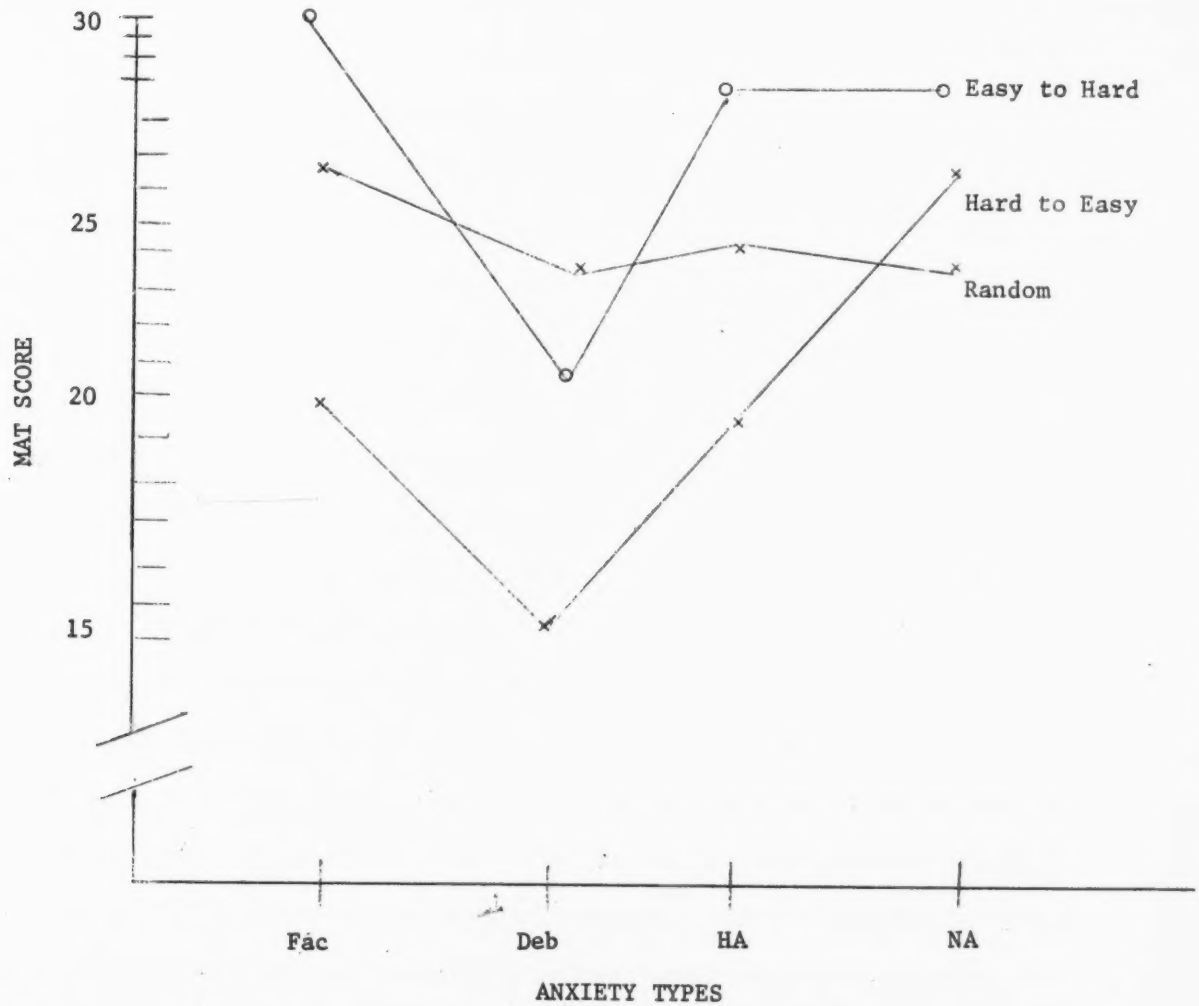

Figure 1.--MAT Performance Score Means of AAT Anxiety Types

The above conclusion is based on the assumption that the maximization of individual test scores will increase their accuracy and predictive validity. However, this assumption needs to be verified in future research. On the other hand, if only one sequence was to be offered to all anxiety types, and one assumed that the sequence which yields the most consistent results across anxiety types would produce the most valid results, then the random sequence would be the best choice. However, this assumption also needs to be verified

One other point of interest for further research deals with the relationship between item difficulty indices and different item sequences. Table 4 shows the item difficulty indices for a given test item in the three different sequences. Table 5 gives the correlation matrix of these item difficulty indices. Obviously, the difficulty of an item is somewhat dependent upon the characteristics of the test in which it appears. The difference between a correlation of .92 (E-H with original Florida twelfth grade data) and .38 (H-E with original Florida twelfth grade data) is striking. The low correlation of .41 between the EH and HE, although significant, leads one to question the concept of an item difficulty index of a test item out of the context of a specific test or, at the least, of a specific difficulty sequence. It is obvious that difficulty indices can and do change drastically depending upon the context in which the item appears.

In conclusion, this research attempt is by no means conclusive in its findings. The results of an aptitude test administered in a timed situation should be compared with the results of the same test in a non-timed situation. Further research should be conducted to determine the usability of the AAT and other measures of student characteristics in the selection of appropriate testing situations for individual students.

TABLE 4

Mathematics Aptitude Test

Item Difficulty Indices[a]

Test Item Number			Difficulty Index			
Easy to Hard	Hard to Easy	Random	Original[b]	Easy to Hard	Hard to Easy	Random
1	48	41	99	1.00	40	82
2	47	25	90	93	44	89
3	46	20	89	79	37	82
4	45	13	88	89	44	89
5	44	18	86	89	33	82
6	43	6	84	79	51	89
7	42	3	82	86	48	85
8	41	22	79	93	55	85
9	40	19	76	79	51	75
10	39	46	74	89	37	42
11	38	11	73	68	29	67
12	37	9	72	82	48	71
13	36	33	71	68	44	89
14	35	39	69	86	55	67
15	34	44	67	68	55	50
16	33	12	65	82	40	67
17	32	48	64	68	48	10
18	31	37	63	55	51	53
19	30	14	61	62	44	32
20	29	26	59	55	70	64
21	28	23	58	44	48	53
22	27	29	57	68	44	64
23	26	43	56	79	55	46
24	25	2	55	65	59	53
25	24	31	54	55	33	46
26	23	1	53	55	62	67
27	22	5	52	62	66	67
28	21	7	52	41	51	53
29	20	38	50	58	55	60
30	19	34	48	55	51	67
31	18	10	47	41	37	53
32	17	24	45	31	51	53
33	16	35	43	48	59	60
34	15	47	42	48	51	21
35	14	40	40	55	55	35

TABLE 4 continued

Test Item Number			Difficulty Index[b]			
Easy to Hard	Hard to Easy	Random	Original	Easy to Hard	Hard to Easy	Random
36	13	27	39	34	44	35
37	12	8	37	51	44	46
38	11	36	35	55	37	35
39	10	16	33	51	22	39
40	9	45	32	48	44	25
41	8	15	30	27	33	42
42	7	32	26	24	14	21
43	6	42	25	24	29	28
44	5	30	22	17	33	28
45	4	28	21	27	33	07
46	3	21	19	10	18	32
47	2	17	19	13	29	39
48	1	4	14	20	18	28

a Decimal points are omitted.
b Based on random sample of 400 Florida twelfth grade students.

TABLE 5

Correlation Matrix of Item Difficulty Indices According to Sequence

	Florida Twelfth Grade Students	Easy-to-Hard Sequence	Hard-to-Easy Sequence	Random Sequence
Florida Twelfth Grade Students	1.0	.9192	.3839	.7972
Easy-to-Hard Sequence		1.0	.4146	.7057
Hard-to-Easy Sequence			1.0	.3737
Random Sequence				1.0

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APPENDIX A

MATHEMATICS APTITUDE TEST

FORM II

MATHEMATICS APTITUDE TEST

GENERAL: This test examines some of the skills you have been learning since you first entered shcool about 15 years ago.

Work carefully, but do not spend too much time on any one question. It is usually better to omit anv question which is difficult for you and then return to it if you have time. You are not expected to answer every question correctly.

You may answer a question even if you are not absolutely sure that your answer is correct. Your score will be the number of correct answers you mark.

Mark all of your answers on the answer sheet. No credit will be given for anything written in the test booklet. If you wish to change an answer, erase your first mark completely. Give only one answer to each question; no credit will be given for multiple answers.

DIRECTIONS: There are 48 problems in this test. Following each problem there are five suggested answers. Work each problem in your head or on the blank space provided at the right of each page. Then look at the five suggested answers and decide which one is correct.

Blacken the space under its letter on the answer sheet.

Sample Problem

How many five-dollar bills are equal to 4 ten-dollar bills?

(A) 2 (B) 8 (C) 10 (D) 20 (E) 40

Because the correct answer to the sample problem is 8, which is lettered B, the space marked B is blackened. See how the sample amswer has been marked.

Sample Answer

A	B	C	D	E
=	●	=	=	=

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

1. If a high school boy is paid at the rate of $1.25 per hour, how much will he earn in an 8-hour working day?

   (A) $8.00 (B) $8.25 (C) $9.25 (D) $10.00 (E) $11.25

2. $\begin{array}{r} 9132 \\ -6724 \\ \hline \end{array}$

   (A) 2408 (B) 2412 (C) 2418 (D) 3412 (E) None of these

3. $0.32 \times 40 = (?)$

   (A) 1.28 (B) 12.5 (C) 12.8 (D) 125 (E) 128

4. A youth club has raised $175 to buy chairs for its recreation room. If 3 chairs cost $25, how many chairs can the club buy?

   (A) 3 (B) 15 (C) 18 (D) 21 (E) 75

5. | 1 gallon = 4 quarts |
   | --- |
   | 1 quart = 2 pints |

   According to the table above, how many pints are equivalent to $7\frac{1}{2}$ gallons?

   (A) 27 (B) 31 (C) 45 (D) 54 (E) 60

6. Jim made runs of 39, 33, 31, and 37 yards in a football game. What was the average length in yards of these runs?

   (A) $32\frac{1}{3}$ (B) $32\frac{1}{2}$ (C) 35 (D) 36 (E) 39

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7. A man bought 15 three-cent stamps and 20 two-cent stamps, How many five-cent stamps could he have bought with the same amount of money?

(A) 4 (B) 7 (C) 9 (D) 17 (E) 18

8. If 4 miniature sandwiches are made from 2 slices of bread, how many of these sandwiches can be made from a loaf that has 20 slices?

(A) 10 (B) 20 (C) 40 (D) 60 (E) 80

9. 10 - 3.807

(A) 6.13 (B) 6.193 (C) 6.293 (D) 7.193 (E) 7.293

10. $43\overline{)301387}$

(A) 790 (B) 7009 (C) 7090 (D) 7900 (E) None of these

11. 60% of 25% = (?)

(A) 15% (B) 85% (C) $41\frac{2}{3}\%$ (D) 85%

(E) None of these

12. 4.38 + 43.8 + .438

(A) 44.676 (B) 47.618 (C) 48.518 (D) 48.618

(E) None of these

13. A man wishes to cover two floors 10' by 15' and 9' by 9' with wall-to-wall carpet. If he has one piece of carpet 19' by 15', how many square feet will be left over?

(A) 54 (B) 60 (C) 90 (D) 135 (E) 204

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14. John's pace is 3 feet while Bill's pace is 2 feet. How many feet apart are they if they start at the same point and take 15 paces in the same direction?

(A) 0 (B) 5 (C) 15 (D) 30 (E) 75

15. 801.4 - 3.802

(A) 797.598 (B) 798.598 (C) 897.598 (D) 4212

(E) None of these

16. If a sum of $749,625 was raised for a new building in a town of 14,900 people, what was the approximate average donation per person?

(A) $5 (B) $10 (C) $25 (D) $50 (E) $500

17. On a certain map, one inch represents 150 miles. How many miles are represented by $3\frac{3}{8}$ inches on the map?

(A) 287.5 (B) 453.75 (C) 487.5 (D) 506.25 (E) 543.75

18. 3) 4 hr. 13 min. 6 sec.

(A) 1 hour 24 minutes 22 seconds

(B) 1 hour 24 minutes $5\frac{1}{2}$ seconds

(C) 1 hour 37 minutes $8\frac{2}{3}$ seconds

(D) 1 hour 37 minutes 42 seconds

(E) None of these

19. A grocer bought 32 bushels of peaches at $1.50 per bushel. Of these, 4 bushels were not sold and the rest were sold at $2.25 a bushel. What was his gross profit?

(A) $15 (B) $18 (C) $24 (D) $48 (E) $63

20. $\frac{16}{5} \div 40 = (?)$

(A) $\frac{2}{25}$ (B) 2 (C) $12\frac{1}{2}$ (D) 128 (E) None of these

21. Change $\frac{5}{6}$ to a per cent.

(A) 80% (B) 83% (C) $83\frac{2}{3}\%$ (D) $87\frac{1}{2}\%$

(E) None of these

22. A skating rink charges 30 cents for children and 60 cents for adults. If a party of 9 people paid $3.00 for tickets, how many in the party were children?

(A) 1 (B) 2 (C) 7 (D) 8 (E) 9

23. A farmer bought 200 pounds of fertilizer for his 10-acre farm. If this amount was just enough for 8 acres, how many more pounds did he need to buy?

(A) 20 (B) 25 (C) 40 (D) 50 (E) 160

24. Three types of seed are tried out with the following results:

Type I: 4 plants from 5 seeds
Type II: 8 plants from 10 seeds
Type III: 40 plants from 50 seeds

If these types continue to produce at these rates, which type or types will produce 80 plants from 100 seeds?

(A) I only (B) II only (C) III only (D) II and III only

(E) I, II, and III

25. How many square feet are there in a hallway $9\frac{1}{3}$ feet long by $5\frac{1}{4}$ feet wide?

(A) 49 (B) $48\frac{11}{12}$ (C) $45\frac{1}{12}$ (D) 42 (E) $28\frac{1}{6}$

26. A squadron consists of 12 to 15 planes. What is the greatest possible number of squadrons in a unit of 180 planes?

(A) 12 (B) 13 (C) 14 (D) 15 (E) 144

27. $\frac{1}{10}$ of $2\frac{1}{2}$ yards = (?) inches

(A) 3 (B) 4 (C) 9 (D) 25 (E) None of these

28. $\frac{749}{8990}$ is approximately

(A) $\frac{1}{15}$ (B) $\frac{1}{12}$ (C) $\frac{5}{6}$ (D) $\frac{7}{8}$ (E) $\frac{8}{9}$

29. $\frac{2}{9}$ of 3 yards is how many inches?

(A) $2\frac{2}{3}$ (B) 8 (C) 12 (D) 18 (E) 24

30. 3 feet $2\frac{5}{8}$ inches
-1 foot $2\frac{3}{4}$ inches

(A) 1 foot $11\frac{1}{8}$ inches
(B) 1 foot $11\frac{7}{8}$ inches
(C) 2 feet $\frac{1}{8}$ inch
(D) 2 feet $\frac{7}{8}$ inch
(E) 2 feet $11\frac{7}{8}$ inches

31. What is the largest number of books each $1\frac{3}{4}$ inches thick that will fit on a shelf which is 2 feet 5 inches long?
(A) 14 (B) 16 (C) 17 (D) 50 (E) 51

32. John and George together have 5 dollars. George and Bill together have 6 dollars. Bill and John together have 7 dollars. How many dollars does George have?

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

33. How many miles per hour must a boat travel in order to go $11\frac{1}{2}$ miles in $1\frac{1}{2}$ hours?

(A) $7\frac{1}{2}$ (B) $7\frac{2}{3}$ (C) $8\frac{1}{4}$ (D) $8\frac{1}{2}$ (E) $8\frac{3}{5}$

34.

1 rod = $5\frac{1}{2}$ yards
1 yard = 36 inches

According to the table above, $1\frac{1}{3}$ rods are equal to how many inches?

(A) 66 (B) 148.5 (C) 198 (D) 257.4 (E) 264

35. How many minutes is $12\frac{1}{2}\%$ of 8 hours?

(A) 1 (B) 6 (C) 60 (D) 100 (E) 125

36. $\dfrac{.32}{.625 \times .032} = (?)$

(A) .016384 (B) .16 (C) .16384 (D) 16 (E) None of these

37. A dealer receives successive discounts of 20% and 10% on a radio which lists for $150. What must he pay for the radio?

(A) $105 (B) $108 (C) $120 (D) $127.50 (E) $147

38. Which of the following equals $\frac{9}{06}$

(A) $\frac{9}{60}$ (B) $\frac{9}{6}$ (C) 15 (D) 54 (E) None of these

39. Write $\frac{1}{200}$ as a decimal.

(A) .0002 (B) .0005 (C) .002 (D) .005 (E) .05

40. What is the average of $\frac{3}{8}$ and $\frac{2}{3}$?

(A) $\frac{1}{4}$ (B) $\frac{7}{24}$ (C) $\frac{15}{24}$ (D) $\frac{25}{48}$ (E) $\frac{25}{24}$

41. 144 square yards equal how many square feet?

(A) 12 (B) 16 (C) 48 (D) 432 (E) 1296

42. Multiplying by 5% gives the same result as dividing by

(A) $\frac{1}{500}$ (B) $\frac{1}{20}$ (C) $\frac{1}{5}$ (D) 5 (E) 20

43. What is the sum of .625 and $\frac{3}{8}$ in fractional form?

(A) $\frac{5}{8}$ (B) $\frac{6}{8}$ (C) $\frac{7}{8}$ (D) $\frac{8}{8}$ (E) None of these

44. How many sixteenths of an inch equal one-tenth of a foot?

(A) 13.3 (B) 16 (C) 16.8 (D) 18 (E) 19.2

45. $\frac{2}{3}$ is what fraction of 6?

(A) $\frac{9}{1}$ (B) $\frac{1}{9}$ (C) $\frac{4}{1}$ (D) $\frac{1}{4}$ (E) $\frac{1}{18}$

46. Change $\frac{1}{8}\%$ to a decimal.

(A) .00125 (B) .0125 (C) .125 (D) 1.25 (E) 12.5

47. If $\frac{5}{6}$ of a scout troop owned uniforms and $\frac{3}{8}$ owned camping kits, what is the <u>smallest</u> fraction of the troop that could own both uniforms and camping kits?

(A) $\frac{5}{24}$ (B) $\frac{5}{16}$ (C) $\frac{1}{2}$ (D) $\frac{11}{24}$ (E) $\frac{29}{24}$

48. If 1 mile = 5280 feet, what is the approximate number of cubic feet in a cubic mile?

(A) 279,000 (B) 147,000,000 (C) 279,000,000

(D) 147,000,000,000 (E) 279,000,000,000

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